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NEW CHAPTERS IN

THE WARFARE OF SCIENCE

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BY

ANDREW DICKSON WHITE

LATE PRESIDENT OF CORNELL UNIVERSITY

IV GEOLOGY

REPRINTED FROM THE POPULAR SCIENCE MONTHLY
FOR FEBRUARY AND MARCH, 1888

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NEW CHAPTERS IN

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GEOLOGY.

PART I.

AMONG the philosophers of Greece and Rome we find, even at an early period, germs of geological truth, and—what is of vast importance—an atmosphere in which such germs could grow. These germs were transmitted to Roman thought; an atmosphere of tolerance continued; there was nothing which forbade unfettered reasoning either upon the earth's strata or upon the remains of former life found in them, and under the empire a period of fruitful observation seemed sure to begin.

But, as Christianity took control of the world, there came a great change. The earliest attitude of the Church toward geology and its kindred sciences was indifferent, and even contemptuous. According to the prevailing belief, the earth was a "fallen world," and was soon to be destroyed. Why, then, should it be studied? Why, indeed, give a thought to it? The scorn which Lactantius had cast upon the study of astronomy was extended largely to other sciences. St. Jerome summed up the general feeling of the Church in his time by asserting that the broken and twisted crust of the ruined earth exhibits the wrath of God against human sin. St. Augustine showed this feeling at various times in a very marked degree.*

But the germs of scientific knowledge and thought developed in the ancient world could be entirely smothered neither by eloquence nor logic, and St. Augustine himself began an effort to evolve from these germs a growth in science which should be "sacred" and "safe." With this intent he prepared his great commentary on the work of creation, as given in Genesis, beside touching upon the subject in other writings. Once engaged in this work, he gave himself to it more earnestly than any other of the earlier fathers ever did; but his vast powers of research and thought were not directed to actual observation or reasoning upon observation; the key-note of his whole method is seen in his famous phrase, "Nothing is to be accepted save on the authority of Scripture, since greater is that authority than all the powers of the human mind." * All his thought was given to studying the letter of the sacred text, and to the application of it by methods purely theological.

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* For a compact and admirable statement as to the dawn of geological conceptions in Greece and Rome, see Mr. Lester Ward's masterly essay on paleobotany in the "Fifth Annual Report of the United States Geological Survey," for 1883-'84. For the reference to St. Jerome, see Shields's "Final Philosophy," p. 119; also Lyell's "Introduction to Geology," vol. i, chapter ii. As to the reasons why Greek philosophers did comparatively so little for geology, see D'Archiac, "Géologie," p. 18.

Among the many questions he then raised and discussed may be mentioned such as these: "What caused the creation of the stars on the fourth day?" "Were beasts of prey and venomous animals created before or after the fall of Adam? If before, how can their creation be reconciled with God's goodness; if afterward, how can their creation be reconciled to the letter of God's word?" "Why were only beasts and birds brought before Adam to be named, and not fishes and marine animals?" "Why did the Creator not say, 'Be fruitful and multiply,' to plants as well as to animals?" †

As to the creation of animals, Augustine curiously anticipates the Darwinian theory in his statement that birds take their origin in water. As to land animals, he holds that insects were not created "actually" during the six days, but only "potentially and virtually" so, since they sprang afterward from carrion.

Such was the contribution of the greatest of the Latin Fathers to the scientific knowledge of the world, after a most thorough study of the biblical text, and a most profound application of theological reasoning. The results of this contribution were most important. In this, as in so many other fields, Augustine gave direction to the main current of thought in Western Europe, Catholic and Protestant, for nearly thirteen centuries.

In the ages that succeeded, the vast majority of prominent scholars followed him implicitly. Even so strong a man as Pope Gregory the Great yielded to his influence, and such leaders of thought as St. Isidore, in the seventh century, and the venerable Bede, in the eighth, planting themselves upon Augustine's premises, only ventured timidly to extend their conclusions upon lines he had laid down.

In his great work on "Etymologies," Isidore took up Augustine's attempt to bring the creation of insects into satisfactory relations with the book of Genesis, and, adopting the theory of the ancient philoso-

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* For citations and authorities on this point, see my chapter on "Meteorology."

† See Augustine, "De Genesi," ii, 13, iii, 13, 15, *et seq.*, ix, 12, *et seq.*

phers, declared that bees are generated out of decomposed veal, beetles out of horse-flesh, grasshoppers out of mules, and scorpions out of crabs. Under the influence of the biblical account of Nebuchadnezzar, which appears to have taken strong hold upon mediæval thought in science, he declared that human beings had been changed into animals, especially into swine, wolves, and owls. As to fossil remains, he, like Tertullian, thought that they resulted from the Flood of Noah.*

In the following century Bede developed the same orthodox traditions in science ; but he held with St. Jerome that the reason why God did not pronounce the work of the second day good is to be found in the fact that there is something essentially evil in the number two. As to the Deluge, he discussed the question as to the amount of food taken into the ark, and declared that there was no need of a supply for more than one day, since God could throw the animals into a deep sleep, or otherwise miraculously make one day's supply sufficient.†

The difficulty in making Noah's ark large enough to contain all the animals had begun to be seriously felt even at that period. Origen had dealt with it by supposing that the "cubit" in Noah's time was six times greater. Bede explained Noah's ability to complete such a Herculean task by supposing that he gave to it a hundred years ; and he leaned toward diminishing the number of animals taken into the ark, supporting himself upon Augustine's theory of the after development of insects out of carrion. In this way the strain upon faith required in believing that all the animals were literally brought into the ark was somewhat lessened.

The best guess in a geological sense among the mediæval followers of St. Augustine was made by an Irish monkish scholar,‡ who, in order to diminish the difficulty arising from the distribution of animals after the flood, especially in view of the fact that the same animals are found in Ireland as in England, held that various lands now separated were once connected. Fortunately for this theologian, the fact that the kangaroo is only found on a continent in the South Pacific, and so, in accordance with the theory, must either by a single leap have jumped from Mount Ararat to Australia, or have found his way across a causeway temporarily erected between Armenia and the South Pacific continent, had not been discovered.

These general lines of thought upon geology and its kindred science of zoölogy were followed by St. Thomas Aquinas and by the whole body of mediæval theologians, so far as they gave any attention to such subjects.

But there was one influence coming from the Hebrew Scriptures which wrought to mitigate ideas regarding the worthlessness of any study of Nature ; this came from the grand utterances in the Psalms regarding the beauty and wonders of creation, and we see the glow of this noble poetry radiated upon those whom logic drew away from studies in natural science. Some of the results produced were indeed curious. Thus, in the science of zoölogy, so essentially connected with geology, Vincent de Beauvais and his compeers, while showing a great desire to display to their readers the glories and wonders of Nature, rely in their attempts to do so, not upon observation but upon authority. Neglecting the wonders which the dissection of any animal would have afforded them, they amplified statements found in various mediæval legends, and especially in the lives of the saints. Hence such additions to learning as careful descriptions of the unicorn and dragon mentioned in Scripture, and such statements as that the lion when pursued by hunters effaces his tracks with the end of his tail ; that the hyena can talk with shepherds, and changes its sex every year ; that a certain bird is born of the fruit of a certain tree when that fruit happens to fall into the water ; and innumerable other statements equally valuable.*

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* See Isidore, "Etymologiæ," xi, 4, xiii, 22.

† See Bede, "Hexæmeron," i, ii.

‡ The so-called Pseudo-Augustine. His treatise, "De mirabilibus mundi," is usually appended to the works of Augustine.

Very pious uses were made of this science, especially by monkish writers. The phœnix rising from his ashes proved the doctrine of the Resurrection ; the structure and mischief of monkeys proved the existence of demons ; the fact that certain monkeys have no tails served to prove that Satan was shorn of his glory ; the weasel, which constantly changes its place, was exhibited as a type of man estranged from the word of God, and finding no rest.†

The next great development, mainly under Church guidance, was by means of the scholastic theology. Phrase-making was substituted for investigation. Without the Church and within it wonderful contributions were thus made. In the eleventh century Avicenna accounted for the fossils by suggesting a "stone-making force" ; ‡ in the thirteenth, Albert the Great attributed them to a "formative quality." # In the following centuries some philosophers ventured the idea that they grew from seed, and the Aristotelian doctrine of spontaneous generation was constantly used to prove that these stony fossils possessed powers of reproduction like plants and animals.‖

Still, at various times and places, germs implanted by Greek and Roman thought were warmed into life. The Arabian schools seem to have been less fettered by the letter of the Koran than the contemporary Christian scholars by the letter of the Bible ; and to Avicenna belongs the credit of first announcing substantially the modern geological theory of changes in the earth's surface. ^

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* See Berger de Xivrey, "Traditions tératologiques," and such mediæval books of *exempla* as the "Lumen animæ."

† See Rambaud, "Histoire de la Civilisation française," Paris, 1885, vol. i, pp. 368, 369.

‡ "Vis lapidifica."

"Virtus formativa."

‖ See authorities given in Mr. Ward's essay, as above.

^ For Avicenna, see Lyell and D'Archiac, and from these it appears that at least one

The direct influence of the Reformation was at first unfavorable to scientific progress. Nothing could be more at variance with any scientific theory of the development of the universe than the ideas of the Protestant leaders. The strict adherence to the text of Scripture which made Luther and Melanchthon denounce the idea that the planets revolve about the sun, would naturally be extended to every other scientific statement apparently at variance with the sacred text. There is much reason to believe that the fetters upon scientific thought were closer under the strict interpretation of Scripture made by the early Protestants than they had been under the older Church. The dominant spirit among the reformers is shown by the declaration of Peter Martyr to the effect that, if a wrong opinion should obtain regarding the creation as described in Genesis, "all the promises of Christ fall into nothing, and all the life of our religion would be lost." * Zwingli, broad as his views on other subjects generally were, was closely bound down in this matter, and held to the opinion of the Fathers, that a great floor separated the heavens from the earth, that above it were the waters and angels, and below it the earth and men. The only scope given to independent thought among the reformers was in a few minor speculations regarding the rivers which encompassed the paradise of Adam and Eve, the exact character of the conversation of the serpent with Eve, and the like. † And in the times immediately succeeding the Reformation matters went from bad to to worse. Under Luther and Melanchthon there was some little freedom of speculation, but under their successors there was none; to question any interpretation of Luther came to be thought almost as wicked as to question the literal interpretation of the Scriptures themselves. Examples of this are seen in the struggles between those who held that birds were created entirely from water and those who held that they were created out of water and mud. The accepted belief being that the "waters above the heavens" were contained in a vast receptacle upheld by a solid vault, when Calixt ventured, in interpreting the Psalms, to question this interpretation, he was bitterly denounced as heretical. ‡

Musæus, in the latter part of the sixteenth century, interpreted the account of Genesis to mean that "first God made the heavens for the roof or vault, and left it there on high swinging until three days later he put the earth under it." # In the city of Lubeck, the ancient center of the great Hanseatic League, close at the beginning of the seven-

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other scholar found as much trouble from Mohammedan as his contemporaries found from Christian religion.

* See his commentary on Genesis, cited by Zöckler, "Geschichte der Beziehungen zwischen Theologie und Naturwissenschaft," vol. i, p. 690.

† See citations in Zöckler, vol. i, p. 693.

‡ See Zöckler, vol. i, p. 679.

See Musæus, "Auslegung des ersten Buchs Mosy," Magdeburg, 1576, cited by Zöckler, vol. ii, pp. 673–677, 761.

teenth century, Pfeiffer, "General Superintendent" or bishop in those parts, published a book entitled "Pansophia Mosaica," calculated, as he believed, to beat back science forever. In a long series of declamations he insisted that in the strict text of Genesis alone is safety; that it contains all wisdom and knowledge, human and divine; that twenty-eight articles of the Augsburg Confession are to be found in it; that it is an arsenal of arguments against all sects and sorts of "Atheists, Heathen, Jews, Turks, Tartars, Papists, Calvinists, Socinians, and Baptists"; the source of all sciences and arts, including law, medicine, philosophy, and rhetoric; "the source and essence of all histories and all professions, trades, and works"; "an exhibition of all virtues and vices"; "the origin of all consolation."* This being the case, who could care to waste time on the study of material things and give thought to the structure of the world? Above all, who, after such a proclamation by such a ruler in the Lutheran Israel, would dare to talk of the "days" mentioned in Genesis as "periods of time"; or of the "firmament" as not meaning a solid vault over the universe; or of the "waters above the heavens," as not contained in a vast cistern supported by the heavenly vault; or of the "windows of heaven" as a figure of speech?

In England the same spirit was shown even as late as the time of Sir Matthew Hale. We find in his book on the "Origination of Mankind," published in 1685, the strictest devotion to a theory of creation based upon the mere letter of Scripture, and a complete incapacity for the attainment of knowledge regarding the earth's origin and structure by any scientific process.

Still, while the Lutheran, Calvinistic, and Anglican reformers clung to literal interpretations of the sacred books, and turned their faces away from scientific investigation, it was among their contemporaries at the coming in of the modern period with the revival of learning that there began to arise fruitful thought in this field. Then it was, about the beginning of the sixteenth century, that Leonardo da Vinci, as great a genius in science as in art, broached the true idea as to the origin of fossil remains; and his compatriot, Fracastoro, developed this on the modern lines of thought. Others in other parts of Europe took up the idea, and, while mixing with it many crudities, evolved from it more and more truth. Toward the end of the sixteenth century Bernard Palissy, in France, took hold of it with the same genius which he showed in artistic creation; but, remarkable as were his assertions of scientific realities, they could gain little hearing. Theologians, philosophers, and even some scientific men of value, under the sway of scholastic phrases, insisted upon such explanations as that fossils were the product of "fatty matter set into a fermentation by heat"; or of a "lapidific juice";† or of a "seminal air";‡ or of a "tumultuous movement of terrestrial exhalations"; and there

* See Zöckler, vol. i, pp. 688, 689. † "Succus lapidificus." ‡ "Aura seminalis."

was a prevailing belief that fossil remains, in general, might be brought under the head of "sports of Nature," a pious turn being given to this phrase by the suggestion that these "sports" were in accordance with some inscrutable purpose of the Almighty.

Such remained a leading orthodox mode of explanation in the Church, Catholic and Protestant, for centuries.

But the better scientific method could not be entirely suppressed; and, near the beginning of the seventeenth century, De Clave, Bitaud, and De Villon revived it in France. Straightway, the theological faculty of Paris protested against the scientific doctrine as unscriptural, destroyed the offending treatises, banished their authors from Paris, and forbade them to live in towns or enter places of public resort.*

The champions of science, though repressed for a time, quietly labored on, and especially in Italy. Half a century later, Steno, a Dane, and Scilla, an Italian, went still further in the right direction; and, though they and their disciples took great pains to throw a tub to the whale, in the shape of sundry vague concessions based upon the book of Genesis, geological truth was more and more developed by them.

In France, the old theological spirit remained more powerful. At the middle of the eighteenth century Buffon made another attempt to state simple geological truths; but the theological faculty of the Sarbonne dragged him at once from his high position, forced him to recant ignominiously, and to print his recantation. This humiliating document reminds us painfully of that forced upon Galileo nearly a hundred years before. It runs as follows: "I declare that I had no intention to contradict the text of Scripture, that I believe most firmly all therein related about the creation, both as to order of time and matter of fact. I abandon everything in my book respecting the formation of the earth, and generally all which may be contrary to the narrative of Moses."

It has been well observed by one of the greatest of modern authorities that the doctrine which Buffon thus "abandoned" is as firmly established as the earth's rotation upon its axis.† Yet one hundred and fifty years were required to secure for it even a fair hearing; the prevailing doctrine of the Church continued to be that "in the beginning God made the heavens and the earth"; that "all things were made at the beginning of the world"; and that to say that stones and fossils were made before or since "the beginning" is contrary to Scripture. Again, we find theological substitutes for scientific explanation ripening into phrases more and more hollow, making fossils "sports of Nature," or "mineral concretions," or "creations of plastic force," or "models" made by the Creator before he had fully decided upon the best manner of creating various beings.

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* See Morley, "Life of Palissy the Potter," vol. ii, p. 315, *et seq.*

† See citation and remark in Lyell's "Principles of Geology," chap. iii, p. 57.

Of this period, when theological substitutes for science were carrying all before them, there still exists a monument commemorating at the same time a farce and a tragedy. This is the work of Johann Beringer, professor in the University of Würzburg and private physician to the Prince-Bishop—the treatise bearing the title "Lithographiæ Wirceburgensis specimen primum," "illustrated with the marvelous likenesses of two hundred figured or rather insectiform stones." Beringer, for the greater glory of God, had previously committed himself so completely to the theory that fossils are simply "stones of a peculiar sort, hidden by the Author of Nature for his own pleasure," * that some of his students determined to give his faith in that pious doctrine a thorough trial. They therefore buried in a place where he was wont to search for specimens a store of sham fossils in baked clay—of their own manufacture—including not only plants, reptiles, and fishes of every sort that their knowledge or imagination could suggest, but even Hebrew and Syriac inscriptions, one of them the name of the Almighty. The joy of the pious professor on unearthing these proofs of the immediate agency of the finger of God in creating fossils knew no bounds. At great cost he prepared this book, whose twenty-two elaborate plates of *fac-similes* were forever to settle the question in favor of theology and against science. Prefixed to the work was an allegorical title-page, wherein not only the glory of his own sovereign, but that of heaven itself, was pictured as based upon a pyramid of these miraculous fossils. So robust was his faith that not even a premature exposure of the fraud could dissuade him from its publication. Dismissing in one contemptuous chapter this exposure as the slander of his rivals, he appealed to the learned world. But the shout of laughter that welcomed the work soon convinced even its author. In vain did he try to suppress it; and, according to tradition, having wasted his fortune in vain attempts to buy up all the copies of it, and, being taunted by the rivals whom he had thought to overwhelm, he died of chagrin. Even death did not end his misfortunes. The copies of the first edition having been sold by a graceless descendant to a Leipsic bookseller, a second edition was brought out under a new title, and this, too, is now much sought as a precious memorial of human folly.†

But even this discomfiture did not end the idea which had caused it, for, although some latitude was allowed among the various theologico-scientific explanations, it was still held meritorious to believe that all fossils were placed in the strata on one of the creative days by the hand of the Almighty, and that this was done for some mysterious purpose, probably for the trial of human faith.

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* See Beringer's "Lithographiæ," etc., p. 91.

† See Carus, "Geschichte der Zoologie," Munich, 1872, p. 467, note, and Reusch, "Bibel und Natur," p. 197. A list of the authorities upon this episode, with the text of one of the epigrams circulated at poor Beringer's expense, is given by Dr. Reuss in the "Serapeum" for 1852, p. 203. The book itself (the original impression) is in the White Library at Cornell University. For Beringer himself, see especially the encyclopædia of Ersch and Gruber, and the "Allg. deutsche Biographie."

Strange as it may at first seem, the theological war upon the true scientific method in geology was waged more fiercely in Protestant countries than in Catholic. The older Church had learned by her earlier wretched mistakes, especially in the cases of Copernicus and Galileo, what dangers to her claim of infallibility lay in meddling with a growing science. In Italy, therefore, comparatively little opposition was made, while England furnished the most bitter opponents to geology so long as the controversy could be maintained and the most active negotiators in patching up a truce on the basis of a sham science afterward. The Church of England did, indeed, produce some noble men, like Bishop Clayton and John Mitchell, who stood firmly by the scientific method; but these appear generally to have been overwhelmed by a chorus of churchmen and dissenters, whose mixtures of theology and science, sometimes tragic in their results and sometimes comic, are among the most instructive things in modern history.*

We have already noted that there are generally three periods or phases in a theological attack upon any science.† The first of these is marked by the general use of scriptural texts and statements against the new scientific doctrine; the third by attempts at compromise by means of far-fetched reconciliations of textual statements with ascertained fact; but the second or intermediate period between these two is frequently marked by the pitting against science of some great doctrine in theology. We saw this in astronomy when Bellarmin and his followers insisted that the scientific doctrine of the earth revolving about the sun is contrary to the theological doctrine of the incarnation. So now against geology it was urged that the scientific doctrine that fossils represent animals which died before Adam contradicts the theological doctrine of Adam's fall and the statement that "death entered the world by sin."

In this second stage of the theological struggle with geology, England was especially fruitful in champions of orthodoxy. First among these may be named Thomas Burnet. In the last quarter of the seventeenth century, just at the time when Newton's great discovery was given to the world, Burnet issued his "Sacred Theory of the Earth." His position was commanding; he was a royal chaplain and a cabinet officer of high standing. Planting himself upon the famous text in the second epistle of Peter,* he declares that the flood had destroyed the old and created a new world. The Newtonian theory he refuses to accept. In his theory of the deluge he lays less stress upon the "opening of the windows of heaven" than upon the "breaking up of the fountains of the great deep." On this latter point he comes forth with great strength. His theory is that the earth is hollow, and filled with fluid like an egg. Mixing together the texts in Genesis and in the second epistle of Peter, the theological doctrine of the "Fall," an astronomical theory regarding the ecliptic, and sundry notions caught from Descartes, he insisted that, before sin brought on the deluge, the earth was of perfect mathematical form, smooth and beautiful, "like an egg," with neither seas nor islands nor valleys nor rocks, "with not a wrinkle, scar, or fracture," and that all creation was equally perfect.

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* For a comparison between the conduct of Italian and English ecclesiastics as regards geology, see Lyell, "Principles of Geology," tenth English edition, vol. i, p. 33. For a philosophical statement of reasons why the struggle was more bitter and the attempt at deceptive compromises more absurd in England than elsewhere, see Maury, "L'ancienne Académie des Sciences," second edition, p. 152. For very frank confessions of the reasons why the Roman Catholic Church has become more careful in her dealings with science, see Roberts, "The Pontifical Decrees against the Earth's Movement," London, 1885, especially pp. 94 and 132, 133, and St. George Mivart's article in the "Nineteenth Century" for July, 1885. The first of these gentlemen is a Roman Catholic clergyman, and the second an eminent layman of the same church, and both admit that it was the Pope, speaking *ex cathedra*, who erred in the Galileo case; but their explanation is that God allowed the Pope and Church to fall into this grievous error, which has cost so dear, in order to show once and for all that the Church has no right to decide questions in science.

† See "The Warfare of Science," original edition, for a discussion of this point.

In the second book of his great work Burnet went still further. As in his first book he had mixed his texts of Genesis and St. Peter with Descartes, he now mixes the account of the Garden of Eden in Genesis with heathen legends of the golden age, and concludes that before the flood there was, over the whole earth, perpetual spring, disturbed by no rain more severe than the falling of the dew.

In addition to his other grounds for denying the earlier existence of the sea, he assigns the reason that, if there had been a sea before the Deluge, sinners would have learned to build ships, and so, when the Deluge set in, could have saved themselves.

The work was written with much power, and attracted universal attention. It was translated into various languages, and called forth a multitude of supporters and opponents in all parts of Europe. Strong men rose against it—especially in England—and among them a few dignitaries of the Church; but the Church generally hailed the work with joy. Addison praised it in a Latin ode, and for nearly a century it exercised a strong influence upon European feeling. It aided to plant more deeply than ever the theological opinion that the existing earth is now but a ruin; whereas, before sin brought on the Flood, it was beautiful in its "egg-shaped form," and free from every imperfection.

A few years later came another writer of the highest standing—William Whiston, professor at Cambridge, who in 1696 published his "New Theory of the Earth." Unlike Burnet, he endeavored to avail himself of the Newtonian idea, and brought in, to aid the geological catastrophe caused by human sin, a comet, which opened "the fountains of the great deep."

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* See II Peter, iii. 6.

But, far more important than either of these champions, there arose in the eighteenth century, to aid in the subjection of science to theology, three men of extraordinary power—John Wesley, Adam Clarke, and Richard Watson. All three were men of extraordinary intellectual gifts, the purest character, and the noblest purpose; and the first-named one of the greatest men in English history. Yet we find them in geology hopelessly fettered by the mere letter of Scripture, and by a temporary phase in theology. As in regard to witchcraft and the doctrine of comets, so in regard to geology, this theological view drew Wesley into enormous error.* The great doctrine which Wesley, Watson, Clarke, and their followers thought it especially necessary to uphold against geologists was, that death entered the world by sin—the first transgression of Adam and Eve. The extent to which the supposed necessity of upholding this doctrine carried Wesley seems now almost beyond belief. Basing his theology on the declaration that the Almighty after creation found the earth and all created things "very good," he declares in his sermon on the "Cause and Cure of Earthquakes," that no one who believes the Scriptures can deny that "sin is the moral cause of earthquakes, whatever their natural cause may be." Again, he declares that earthquakes are the "effect of that curse which was brought upon the earth by the original transgression." Bringing into connection with Genesis the declaration of St. Paul that "the whole creation groaneth and travaileth together in pain until now," he finds additional scriptural proof that the earthquakes were the result of Adam's fall. He declares, in his sermon on "God's Approbation of His Works," that "before the sin of Adam there were no agitations within the bowels of the earth, no violent convulsions, no concussions of the earth, no earthquakes, but all was unmoved as the pillars of heaven. There were then no such things as eruptions of fires; no volcanoes or burning mountains." Of course, a science which showed that earthquakes had been in operation for ages before the appearance of man on the planet, and which showed, also, that those very earthquakes which he considered as curses resultant upon the Fall were really blessings, producing the fissures in which we find to-day those mineral veins so essential to modern civilization, was entirely beyond his comprehension. He insists that earthquakes are "God's strange works of judgment, the proper effect and punishment of sin."

So, too, as to death and pain. In his sermon on the "Fall of Man" he takes the ground that death and pain entered the world by Adam's transgression, insisting that the carnage now going on among animals is the result of Adam's sin. Speaking of the birds, beasts, and insects, he says that, before sin entered the world by Adam's fall, "none of these attempted to devour or in any way hurt one another"; that "the spider was then as harmless as the fly and did not then lie in wait for blood." * Here, again, Wesley arrayed his early followers against geology, which reveals, in the fossil remains of carnivorous animals, pain and death countless ages before the appearance of man. The half-digested fragments of weaker animals within the fossilized bodies of the stronger have destroyed all Wesley's arguments in behalf of his great theory.

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* For his statement that "the giving up of witchcraft is in effect the giving up of the Bible," see Wesley's "Journal," 1766–'68.

Dr. Adam Clarke held similar views. He insisted that thorns and thistles were given as a curse to human labor, on account of Adam's sin, and appeared upon the earth for the first time after Adam's fall. So, too, Richard Watson, the most prolific writer of the great evangelical reform period, and the author of the "Institutes," the standard theological treatise in the evangelical army, says, in a chapter treating of the Fall, and especially of the serpent which tempted Eve: "We have no reason at all to believe that the animal had a serpentine form in any mode or degree until his transformation. That he was then degraded to a reptile, to go upon his belly, imports, on the contrary, an entire alteration and loss of the original form." All that admirable adjustment of the serpent to its environment which delights naturalists, was to Adam Clarke simply an evil result of the sin of Adam and Eve. Yet here again geology was obliged to confront theology in revealing the *python* in the Eocene—ages before man appeared. †

The immediate results of such teaching by such men was to throw many who would otherwise have resorted to observation and investigation back upon scholastic methods. Again reappears the old system of solving the riddle by phrases. In 1733, Dr. Theodore Arnold urged the theory of "models," and insisted that fossils result from "infinitesimal particles brought together in the creation to form the outline of all the creatures and objects upon and within the earth"; and Arnold's work translated into German gained wide acceptance. ‡

Such was the influence of this succession of great men that toward the close of the last century the English opponents of geology on biblical grounds seemed likely to sweep all before them. Cramping our whole inheritance of sacred literature within the rules of an historical compend, they showed the terrible dangers arising from the revelations of geology, which make the earth older than the six thousand years required by Archbishop Usher's interpretation of the Old Testament. Nor was this feeling confined to ecclesiastics. Williams, a thoughtful layman, declared that such researches led to infidelity and atheism, and are "nothing less than to depose the Almighty Creator of the universe from his office." The poet Cowper, one of the mildest of men, was also roused by these dangers, and in his most elaborate poem wrote:

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* See Wesley's sermon on "God's Approbation of His Works," 11th and 12th parts.

† See "Westminster Review," October, 1870, article on "John Wesley's Cosmogony," with citations from Wesley's "Sermons," Watson's "Institutes of Theology," Adam Clarke's "Commentary on the Holy Scriptures," etc.

‡ See citation in Mr. Ward's article, as above, p. 390.

> "Some drill and bore
> The solid earth, and from the strata there
> Extract a register, by which we learn
> That he who made it, and revealed its date
> To Moses, was mistaken in its age!"

Howard summoned England to oppose "those scientific systems which are calculated to tear up in the public mind every remaining attachment to Christianity." *

While this great attack upon geological science by means of the dogma of Adam's fall was kept up, the more general attack by the literal interpretation of the text was continued. The legendary husks and rinds of our sacred books were insisted upon as equally precious and nutritious with the great moral and religious truths which they envelop. Especially precious were the six days—each "the evening and the morning"—and the exact statements as to the time when each part of creation came into being. To save these the struggle became more and more desperate.

Difficult as it is to realize it now, within the memory of many now living the battle was still raging most fiercely in England, and both kinds of artillery usually brought against a new science were in full play, and filling the civilized world with their roar.

About forty years ago, the Rev. J. Mellor Brown, the Rev. Henry Cole, and others, were hurling at all geologists alike, and especially at such Christian divines as Dr. Buckland and Dean Conybeare and Pye Smith, and such religious scholars as Professor Sedgwick, the epithets of "infidel," "impugner of the sacred record," and "assailant of the volume of God." †

The favorite weapon of the orthodox party was the charge that the geologists were "attacking the truth of God." They declared geology "not a subject of lawful inquiry," denouncing it as "a dark art," as "dangerous and disreputable," as "a forbidden province," as "infernal artillery," and as "an awful evasion of the testimony of revelation." ‡

This attempt to scare men from the science having failed, various other means were taken. To say nothing about England, it is humiliating to human nature to remember the annoyances, and even trials, to which the pettiest and narrowest of men subjected such Christian scholars in our own country as Benjamin Silliman and Edward Hitchcock and Louis Agassiz.

But it is a duty and a pleasure to state here that one great Chris-

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* See Lyell, "Introduction."

† For these citations, see Lyell, "Principles of Geology," introduction.

‡ See Pye Smith, D. D., "Geology and Scripture," pp. 156, 157, 168, 169.

tian scholar did honor to religion and to himself by quietly accepting the claims of science and making the best of them, despite all these clamors. That man was Nicholas Wiseman, better known afterward as Cardinal Wiseman. The conduct of this pillar of the Roman Catholic Church contrasts admirably with that of timid Protestants, who were filling England with shrieks and denunciations.*

And here let me note that one of the most interesting skirmishes in this war was made in New England. Professor Stuart, of Andover, justly honored as a Hebrew scholar, declared that to speak of six periods of time for the creation was flying in the face of Scripture; that Genesis expressly speaks of six days, each made up of "the evening and the morning," and not six periods of time.

To him replied a professor in Yale College, James Kingsley. In an article admirable for keen wit and kindly temper, he showed that Genesis speaks just as clearly of a solid firmament as of six ordinary days, and that, if Professor Stuart had got over one difficulty and accepted the Copernican theory, he might as well get over another and accept the revelations of geology. The encounter was quick and decisive, and the victory was with science and our own honored Yale.†

But perhaps the most singular attempt against geology was made by a fine specimen of the English Don—Dean Cockburn, of York—to *scold* its champions out of the field. Having no adequate knowledge of geology, he opened a battery of abuse. He gave it to the world at large by pulpit and press; he even inflcited it upon leading statesmen by private letters.‡ From his pulpit in York Minster, Mary Somerville was denounced coarsely, by name, for those studies in physical geography which have made her honored throughout the world.#

But these weapons did not succeed; they were like Chinese gongs and dragon-lanterns against rifled cannon, and we are now to look at a very different chapter in this war. This chapter will form the next subject of our study.

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* Wiseman, "Twelve Lectures on the Connection between Science and Revealed Religion," first American edition, New York, 1837. As to the comparative severity of the struggle regarding astronomy, geology, etc., in Catholic and Protestant countries, see Lecky, "England in the Eighteenth Century," chap. ix, p. 525.

† See "Silliman's Journal," vol. xxx, p. 114.

‡ Professor Goldwin Smith informs me that the papers of Sir Robert Peel, yet unpublished, contain very curious specimens of these epistles.

See "Personal Recollections of Mary Somerville," Boston, 1874, pp. 139 and 375. Compare with any statement of his religious views that Dean Cockburn was able to make, the following from Mrs. Somerville: "Nothing has afforded me so convincing a proof of the Deity as these purely mental conceptions of numerical and mathematical science which have been, by slow degrees, vouchsafed to man—and are still granted in these latter times by the differential calculus, now superseded by the higher algebra—all of which must have existed in that sublimely omniscient mind from eternity." (See "Personal Recollections," pp. 140, 141.)

PART II.

Long before the end of the struggle described in the last article, even at a very early period, the futility of the usual scholastic weapons had been seen by the more keen-sighted champions of orthodoxy; and, as the difficulties of the ordinary attack upon science became more and more evident, many of these champions began endeavors to patch up a truce. So began the third stage in the war—the period of attempts at compromise.

The position which the compromise party took was that the fossils were produced by the Deluge of Noah.

This position was strong, for it was apparently based upon Scripture. Moreover, it had high ecclesiastical sanction—some of the fathers had held that fossil remains, even on the highest mountains, represented animals destroyed at the Deluge—Tertullian was especially firm on this point, and St. Augustine thought that a fossil tooth discovered in North Africa must have belonged to one of the giants mentioned in Scripture.*

In the sixteenth century especially, weight began to be attached to this idea by those who felt the worthlessness of various scholastic explanations. Strong men in both the Catholic and the Protestant camps accepted it; but the man who did most to give it an impulse into modern theology was Martin Luther. With his keen eye he saw that scholastic phrase-making could not meet the difficulties raised by fossils, and he naturally urged the doctrine of their origin at the Deluge of Noah.†

With such support, it soon became the dominant theory in Christendom. Nothing seemed able to stand against it, but before the end of the same sixteenth century it met some serious obstacles. Bernard Palissy, one of the most keen-sighted of scientific thinkers in France, as well as one of the most devoted of Christians, showed that this theory was utterly untenable. Conscientious investigators in other parts of Europe, and especially in Italy, showed the same thing.‡ All in vain—in vain did good men protest against the injury sure to be brought upon religion by tying it to a scientific theory sure to be exploded; the doctrine that fossils were the remains of animals drowned at the Flood continued to be upheld by the great majority of theological leaders for nearly three centuries as "sound doctrine," and as a blessed means of reconciling science with Scripture.* To sustain this scriptural view, efforts were put forth absolutely Herculean both by Catholics and Protestants.

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* For Tertullian, see his "De Pallio," c. ii (Migne, "Patr. Lat.," ii, 1033). For Augustine's view, see Cuvier, "Recherches sur les Ossements fossiles," fourth edition, vol. ii, p. 143.

† For Luther's opinion, see his "Commentary on Genesis."

‡ For a very full statement of the honorable record of Italy in this respect, and for the enlightened views of some Italian churchmen, see Stoppani, "Il Dogma e le Scienze Positive," Milan, 1886, pp. 203 *et seq.*

In Germany, early in the seventeenth century (1612), Dr. Wolfgang Franz, Professor of Theology at Wittenberg, published his "Sacred History of Animals," described dragons with three ranges of teeth, and calmly added, "The greatest of these is the devil." This book was influential upon thought for a hundred years. It claimed to be designed for "students of theology and ministers of the word," and especially to instruct clergymen how, in biblical fashion, to utilize the various traits of animals to the edification of their hearers.†

In France the learned Benedictine, Calmet, in his great works on the Bible, accepted this view as late as the beginning of the eighteenth century, believing the mastodon's bones exhibited by Mazurier to be those of King Teutobocus, and held them valuable testimony to the existence of the giants mentioned in Scripture and of the early inhabitants of the earth overwhelmed by the Flood.‡

But the greatest champion appeared in England. We have already seen how, near the close of the seventeenth century, Thomas Burnet prepared the way in his "Sacred Theory of the Earth" by rejecting the discoveries of Newton, and showing how sin led to the breaking up of the "foundations of the great deep"; and we have also seen how Whiston, in his "New Theory of the Earth," while yielding a little and accepting the discoveries of Newton, brought in a comet to aid in producing the Deluge; but far more important than these in his permanent influence was John Woodward, professor at Gresham College, a leader in scientific thought at the University of Cambridge, and, as a patient collector of fossils and an earnest investigator of their meaning, deserving of the highest respect. In 1695 he published his "Natural History of the Earth," and rendered one great service to science, for he yielded another point, and thus destroyed the foundations for the old theory of fossils. He showed that they were not "sports of Nature," or "models inserted by the Creator in the strata for some inscrutable purpose," but that they were really remains of living beings. So far, he rendered a great service both to science and religion; but, this done, the text of the Old Testament narrative and the famous passage in St. Peter's Epistle were too strong for him, and he, too, insisted that the fossils were produced by the Deluge. Strengthened by his great authority, the assault on the true scientific position was strong: Mazurier exhibited certain fossil remains of a mammoth discovered in France as bones of the giants mentioned in

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* See Audiat, "Vie de Palissy," p. 412, and Cantu, "Hist. universelle," vol. xv, p. 492.

† See Franz, "Historia Animalium," edition of 1671, especially in the preface; also Perrier, "La Philosophie zoologique avant Darwin," Paris, 1884, p. 29.

‡ See Calmet, "Dissertation sur les Géants," cited in Berger de Xivrey, "Traditions tératologiques," p. 191.

Scripture; Father Torrubia did the same thing in Spain; Increase Mather sent to England similar remains discovered in America, with a like statement.

For the edification of the faithful, such "bones of the giants mentioned in Scripture" were hung up in public places. Jurieu saw some of them thus suspended in one of the churches of Valence; and Henrion, apparently under the stimulus thus given, drew up tables showing the size of our antediluvian ancestors, in which the height of Adam was given as 123 feet 9 inches, that of Eve as 118 feet 9 inches and 9 lines.*

But the most brilliant service rendered to the theological theory came from another quarter; for, in 1726, Scheuchzer, having discovered a large fossil lizard, exhibited it to the world as the "human witness of the Deluge"; † this great discovery was hailed everywhere with joy, for it seemed to prove not only that human beings were drowned at the Deluge, but that "there were giants in those days." Cheered by the applause thus gained, he determined to make the theological position impregnable. Mixing together various texts of Scripture with notions derived from the philosophy of Descartes and the speculations of Whiston, he developed the theory that "the fountains of the great deep" were broken up by the direct physical action of the hand of God, which, literally applied to the axis of the earth, suddenly stopped the earth's rotation, broke up "the fountains of the great deep," spilled the water therein contained, and produced the Deluge. But his service to sacred science did not end here, for he prepared an edition of the Bible, in which magnificent engravings in great number illustrated his view and enforced it upon all readers. Of these engravings no less than thirty-four were devoted to the Deluge alone.‡

In the midst of this war appeared an episode very comical but very instructive; for it shows that the attempt to shape the deductions of science to meet the exigencies of theology may mislead heterodoxy as absurdly as orthodoxy.

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* See Cuvier, "Recherches sur les Ossements fossiles," fourth edition, vol. vii, p. 56; also, Geoffroy St.-Hilaire, cited by Berger de Xivrey, "Traditions tératologiques," p. 190.

† "Homo diluvii testis."

‡ See Zöckler, vol. ii, p. 172. For the ancient belief regarding giants, see Leopardi, "Saggio." For accounts of the views of Mazurier and Scheuchzer, see Cuvier; also, Büchner, "Man in Past, Present, and Future," English translation, pp. 235, 236. For Increase Mather's views, see "Philosophical Transactions," vol. xxiv, p. 85. As to similar fossils sent from New York to the Royal Society as remains of giants, see Weld, "History of the Royal Society," vol. i, p. 421. For Father Torrubia and his "Gigantologia Española," see D'Archiac, "Introduction à l'Étude de la Paléontologie stratographique," Paris, 1864, p. 201. For admirable summaries, see Lyell, "Principles of Geology," London, 1867; D'Archiac, "Géologie et Paléontologie," Paris, 1866; Pictet, "Traité de Paléontologie," Paris, 1853; Vezian, "Prodrome de la Géologie," Paris, 1863; Haeckel, "History of Creation," English translation, New York, 1876, chapter iii; and, for the most recent progress, Professor O. S. Marsh's "Address on the History and Methods of Paleontology," given at Saratoga in 1879.

About the year 1760 news of the discovery of marine fossils in various elevated districts of Europe reached Voltaire. He, too, had a theologic system to support, though his system was opposed to that of the sacred books of the Hebrews. He feared that these new discoveries might be used to support the Mosaic accounts of the Deluge: all his wisdom and wit, therefore, were compacted into arguments to prove that the fossil fishes were remains of fishes intended for food, but spoiled and thrown away by travelers; that the fossil shells were accidentally dropped by Crusaders and Pilgrims returning from the Holy Land; and that sundry fossil bones found between Paris and Étampes were parts of a skeleton belonging to the cabinet of some ancient philosopher. Through chapter after chapter, Voltaire, obeying the supposed necessities of his theology, fought desperately the growing results of the geologic investigations of his time.*

But far more prejudicial to Christianity was the continued effort on the other side to show that the fossils were caused by the Deluge of Noah.

No supposition was too violent to support this theory, which was considered vital to the Bible. By taking the mere husks and rinds of biblical truth for truth itself, by taking sacred poetry as prose, and by giving a literal interpretation of it, the followers of Burnet, Whiston, and Woodward built up systems which bear to real geology much the same relation that the "Christian Topography" of Cosmas bears to real geography. In vain were exhibited the absolute geological, zoölogical, astronomical proofs that no universal deluge, or deluge covering any great extent of the earth, had taken place within the last six thousand or sixty thousand years; in vain did so enlightened a churchman as Bishop Clayton declare that the Deluge could not have taken place save in that district where Noah lived before the Flood; in vain did others, like Bishop Croft and Bishop Stillingfleet, and the nonconformist Matthew Poole, show that the Deluge might not have been and probably was not universal; in vain was it shown that, even if there had been a universal deluge, the fossils were not produced by it: the only answers were the citation of the text, "And all the high mountains which were under the whole heaven were covered," and, to clinch the matter, Worthington and men like him insisted that any argument to show that fossils were not remains of animals drowned at the Deluge of Noah was "infidelity." In England, France, and Germany, belief that the fossils were produced by the Deluge of Noah was insisted upon as part of that faith essential to salvation.†

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* See Voltaire, "Dissertation sur les Changements arrivés dans notre Globe"; also, Voltaire, "Les Singularités de la Nature," chapter xii; also, Jevons, "Principles of Science," vol. ii, p. 328.

† For a candid summary of the proofs from geology, astronomy, and zoölogy, that the Noachian Deluge was not universally or widely extended, see McClintock and Strong, "Cyclopædia of Biblical Theology and Ecclesiastical Literature," article "Deluge." For general history, see Lyell, D'Archiac, and Vezian. For special cases showing the bitterness of the conflict, see the Rev. Mr. Davis's "Life of Rev. Dr. Pye Smith," *passim*.

But the steady work of science went on; not all the force of the Church—not even the splendid engravings in Scheuchzer's Bible—could stop it; and the foundations of this theological theory began to crumble away. The process was, indeed, slow; it required a hundred and twenty years for the searchers of God's truth, as revealed in Nature—such men as Hooke, Linnæus, Whitehurst, Daubenton, and Cuvier—to push their works under this fabric of error, and, by statements which could not be resisted, to undermine it. As we arrive at the beginning of the nineteenth century, science is becoming irresistible in this field. Blumenbach, Von Buch, and Schlotheim lead the way, but most important is the work of Cuvier. In the early years of the present century, his researches among fossils began to throw new light into the whole subject of geology: he was, indeed, very wary and diplomatic, and seemed, like Voltaire, to feel that "among the wolves one must howl a little." It was a time of reaction. Napoleon had made peace with the Church, and to disturb that peace was akin to treason. Still, by large but vague concessions, Cuvier kept the theologians satisfied, while he undermined their strongest fortress. The danger was instinctively felt by some of the champions of the Church, and typical among these was Chateaubriand; and in his best-known work, once so great, now so little—the "Genius of Christianity"—he grappled with the questions of creation by insisting upon a sort of general deception "in the beginning," under which everything was created by a sudden fiat, but with appearances of pre-existence. His words are as follows: "It was part of the perfection and harmony of the nature which was displayed before men's eyes that the deserted nests of last year's birds should be seen on the trees, and that the sea-shore should be covered with shells which had been the abode of fish, and yet the world was quite new, and nests and shells had never been inhabited." * But the real victory was with Brongniart, who, about 1820, gave forth his work on fossil plants, and thus built a barrier against which the enemies of science raged in vain.†

Still the struggle was not ended, and, a few years later, a forlorn hope was led in England by Granville Penn.

His fundamental thesis was that "our globe has undergone only two revolutions, the Creation and the Deluge, and both by the immediate fiat of the Almighty"; he insisted that the Creation took place in exactly six days of ordinary time, each made up of "the evening and the morning"; and he ended with a piece of that peculiar presumption so familiar to the world, by calling on Cuvier and all other geologists to "ask for the old paths and walk therein until they shall simplify their system and reduce their numerous revolutions to the two events or epochs only—the six days of Creation and the Deluge." ‡

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* "Génie du Christianisme," chapter v, pp. 1–14, cited by Reusch, vol. i, p. 250.

† For admirable sketches of Brongniart and other paleobotanists, see Ward, as above.

‡ See the works of Granville Penn, vol. ii, p. 273.

The geologists showed no disposition to yield to this peremptory summons ; on the contrary, the President of the British Geological Society, and even so eminent a churchman and geologist as Dean Buckland, soon acknowledged that facts obliged them to give up the theory that the fossils of the coal-measures were deposited at the Deluge of Noah, and to deny that the Deluge was universal. The combat deepened ; churchmen and dissenters were alike aroused ; from pulpit and press missiles were showered upon men of science. As typical we may take Fairholme, who in 1837 published his "Mosaic Deluge" and argued that no early convulsions of the earth, such as those supposed by geologists, could have taken place, because there could have been no deluge "before moral guilt could possibly have been incurred"—that is to say, before the creation of mankind. In touching terms he bewailed the defection of the President of the Geological Society and Dean Buckland—protesting against geologists who "persist in closing their eyes upon the solemn declarations of the Almighty."*

Still the geologists continued to seek truth, and those theologians who felt that denunciation of science as "godless" could accomplish little labored upon schemes for reconciling geology with Genesis. Some of these show amazing ingenuity, but an eminent religious authority, going over them with great thoroughness, has well characterized them as "daring and fanciful."† Such attempts have been variously classified ; but the fact regarding them all is that each mixes up more or less of science with more or less of Scripture, and produces a result more or less absurd. Though a few men here and there have continued these exercises, the capitulation of the party which set the literal account of the Deluge of Noah against the facts revealed by geology was at last clearly made.

One of the first evidences of the completeness of this surrender has been so well related by the eminent physiologist, Dr. W. B. Carpenter, that it may best be given in his own words : "You are familiar with a book of considerable value, Dr. W. Smith's 'Dictionary of the Bible.' I happened to know the influences under which that dictionary was framed. The idea of the publisher and of the editor was to give as much scholarship and such results of modern criticism as should be compatible with a very judicious conservatism. There was to be no objection to geology, but the universality of the Deluge was to be strictly maintained. The editor committed the article 'Deluge' to a man of very considerable ability, but, when the article came to him, he found that it was so excessively heretical that he could not venture to put it in. There was not time for a second article under that head, and, if you look in that dictionary, you will find under the word 'Deluge' a reference to 'Flood.' Before 'Flood' came, a second article had been commissioned from a source that was believed safely conservative. But, when the article came in, it was found to be worse than the first. A third article was then commissioned, and care was taken to secure its 'safety.' If you look for the word 'Flood' in the dictionary, you will find a reference to 'Noah.' Under that name you will find an article written by a distinguished professor of Cambridge, of which I remember that Bishop Colenso said to me at the time, 'In a very guarded way the writer concedes the whole thing.' You will see by this under what trammels scientific thought has labored in this department of inquiry."[*]

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* See Fairholme, "Mosaic Deluge," London, 1837, p. 358.

† See Shields, "The Final Philosophy," p. 340.

A similar surrender was seen when from a new edition of ~~Bishop~~ Horne's "Introduction to the Scriptures," the standard text-book of orthodoxy, its accustomed use of fossils to prove the universality of the Deluge was quietly dropped.[†]

The date of a similar capitulation in the United States was fixed, when somewhat later two divines, among the most eminent for piety and scholarship, inserted in the "Biblical Cyclopædia" published under their supervision, a candid summary of the proofs from geology, astronomy, and zoölogy that the Deluge of Noah was not universal, or even widely extended, and this without protest from any man of note in any branch of the American Church.[‡]

The time when the struggle was relinquished by enlightened theologians of the Roman Catholic Church may be fixed at about 1862, when Reusch, professor of theology at Bonn, in his work on "The Bible and Nature," cast off the old diluvial theory and all its supporters, accepting the conclusions of science.[#]

But, though the sacred theory with the Deluge of Noah as a universal solvent for geological difficulties was dead, there still remained in various quarters a touching fidelity to its memory. In Roman Catholic countries the old theory has been widely though quietly cherished and taught from the religious press, the pulpit, and the theological professor's chair: Pope Pius IX was doubtless in sympathy with this feeling when, about 1850, he forbade the scientific congress of Italy to meet at Bologna.[‖]

In 1856 Father Debreyne congratulated the theologians of France on their admirable attitude: "instinctively," he says, they still insist upon deriving the fossils from Noah's Flood.[△] In 1875 the Abbé Choyer published at Paris and Angers a text-book widely approved by church authorities, in which he took similar ground; and in 1877 the Jesuit father, Bosizio, published at Mayence a treatise on geology and the Deluge, endeavoring to hold the world to the old solution of the problem, allowing, indeed, that the "days" of creation were long periods, but making atonement for this concession by sneers at Darwin.*

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[*] See "Official Report of the National Conference of Unitarian and other Christian Churches, held at Saratoga, 1882," p. 97.

[†] This was about 1856; see Tylor, "Early History of Mankind," p. 328.

[‡] McClintock and Strong, "Cyclopædia of Biblical Knowledge," etc., article "Deluge."

[#] See Reusch, "Bibel und Natur," chap. xxi.

[‖] See Whiteside, "Italy in the Nineteenth Century," vol. iii, chap. xiv.

[△] See Zöckler, vol. ii, p. 472.

In the Russo-Greek Church, in 1869, Archbishop Macarius, of Lithuania, urged the necessity of believing that Creation in six days of ordinary time and the Deluge of Noah are the only causes of all that geology seeks to explain; and, as late as 1876, another eminent theologian of the same church went even farther, and refused to allow the faithful to believe that any change had taken place since "the beginning" mentioned in Genesis, when the strata of the earth were laid, tilted, and twisted, and the fossils scattered among them by the hand of the Almighty during six ordinary days.†

In the Lutheran branch of the Protestant Church we also find some echoes of the old belief. Keil, eminent in scriptural interpretation at the University of Dorpat, gave forth in 1860 a treatise insisting that geology is rendered futile and its explanations vain by two great facts—the Curse which drove Adam and Eve out of Eden, and the Flood that destroyed all living things save Noah, his family, and the animals in the ark. In 1867, Phillippi, and in 1869, Diedrich, both theologians of eminence, took virtually the same ground in Germany, the latter attempting to beat back the scientific hosts with a phrase apparently pithy, but really hollow—the declaration that "modern geology observes what is, but has no right to judge concerning the beginning of things." As late as 1876, Zugler took a similar view, and a multitude of lesser lights, through pulpit and press, brought these anti-scientific doctrines to bear upon the people at large—the only effect being to deaden the intellects of the peasantry in general and to arouse grave doubts regarding Christianity among the more thoughtful young men, who naturally distrusted a cause using such weapons.‡

The results of this policy, both in Roman Catholic and in Protestant countries, are not far to seek. What the condition of thought is among the middle classes of France and Italy needs not to be stated here. In Germany, as a typical fact, it may be mentioned that there was in the year 1881 church accommodation in the city of Berlin for but two per cent of the population, and that even this accommodation was more than was needed. This fact is not due to the want of a deep religious spirit among the North Germans: no one who has lived among them can doubt the existence of such a spirit; but it is due mainly to the fact that, while the simple results of scientific investigation have filtered down among the people at large, the dominant party in the Lutheran Church has steadily refused to recognize this fact, and has persisted in imposing on Scripture the fetters of literal and dogmatic interpretation which Germany has largely outgrown.* A similar danger threatens every other country in which the clergy pursue a similar policy. No thinking man, whatever may be his religious views, can fail to regret this. A thoughtful, reverent, enlightened clergy is a great blessing to any country ; and anything which undermines their legitimate work of leading men out of the worship of material things to the consideration of that which is higher, is a vast misfortune.

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* See Zöckler, vol. ii, p. 478, and Bosizio, "Geologie und die Sündfluth," Mayence, 1877, preface, p. xiv.

† See Zöckler, vol. ii, pp. 472, 571.

‡ See citations in Zockler, Reusch, and Shields.

But, before concluding this part of the subject, it may be instructive to note a few special attempts at truces or compromises, such as always appear when the victory of any science becomes sure. Typical among the latest of these may be mentioned the attempt of Carl von Raumer in 1819. With much pretension to scientific knowledge, but with aspirations bounded by the limits of Prussian orthodoxy, he made a labored attempt to produce a statement which, by its vagueness, haziness, and "depth," should obscure the real questions at issue. This statement appeared in the shape of an argument, used by Bertrand and others in the previous century, to prove that fossil remains of plants in the coal-measures had never existed as living plants, but had been simply a "result of the development of imperfect plant embryos" ; and the same misty theory was suggested to explain the existence of fossil animals without supposing the epochs and changes required by geological science.

In 1837 Wagner sought to uphold this explanation ; but it was so clearly a mere hollow phrase, unable to bear the weight of the facts to be accounted for, that it was soon given up.

Similar attempts were made throughout Europe, the most noteworthy appearing in England. In 1853 was issued an anonymous work, having as its title "A Brief and Complete Refutation of the Anti-Scriptural Theory of Geologists": the author reviewed an old idea, but put a spark of life into it—this idea being that "all the organisms found in the depths of the earth were made on the first of the six creative days, as models for the plants and animals to be created on the third, fifth, and sixth days." †

But, while these attempts to preserve the old theory as to fossil remains of lower animals were thus pressed, there appeared upon the geological field a new scientific column far more terrible to the old doctrines than any which had been seen previously.

For, just at the close of the first quarter of the nineteenth century, geologists began to examine the caves and beds of drift in various parts of the world ; and, within a few years from that time, a series of discoveries began in France, in Belgium, in England, in Brazil, in

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* For these statements regarding Germany the writer relies on his personal observation as a student at the University of Berlin in 1856, as a traveler at various periods afterward, and as Minister of the United States in 1879, 1880, and 1881.

† See Zöckler, vol. ii, p. 475.

Sicily, and in India which have established the fact that a period of time much greater than any which had before been thought of had elapsed since the first human occupation of the earth. The chronologies of Archbishop Usher, Petavius, Bossuet, and the other great authorities on which theology had securely leaned, fell. It was clearly seen that, no matter how well based upon the Old Testament genealogies and lives of the patriarchs, all these systems must go for nothing. The most conservative geologists were gradually obliged to admit that man had been upon the earth not merely six thousand, or sixty thousand, or one hundred and sixty thousand years. A very moderate estimate has made the time that the evolution of human civilization under the guidance of man has required fully a quarter of a million of years.*

The supporters of a theory based upon the letter of Scripture, who had so long taken the offensive, were now obliged to fight upon the defensive and at fearful odds. Various lines of defense were taken; but perhaps the most pathetic effort was that made in the year 1857, in England, by Gosse. As a naturalist he had rendered great services to zoölogical science, but he now concentrated his energies upon one last effort to save the literal interpretation of Genesis and the theological structure built upon it. In his work entitled "Omphalos" he developed the theory previously urged by Granville Penn, and asserted a new principle, called "prochronism." In accordance with this, all things were created by the Almighty hand literally within the six days, each made up of "the evening and the morning," and each great branch of creation was brought into existence in an instant. Accepting a declaration of Dr. Ure, that "neither reason nor revelation will justify us in extending the origin of the material system beyond six thousand years from our own days," Gosse held that all the evidences of convulsive changes and long epochs in strata, rocks, minerals, and fossils are simply "*appearances*"—only that and nothing more. Among these mere "appearances," all created instantaneously, were the glacial furrows and scratches on rocks, the marks of retreat seen in the wearing away of rocky masses, as at Niagara, the tilted and twisted strata, the piles of lava from extinct volcanoes, the fossils of every sort in every part of the earth, the foot-tracks of birds and reptiles, the half-digested remains of weaker animals found in the fossilized bodies of the stronger, the marks of hyenas' teeth on fossilized bones found in various caves, and even the skeleton of the Siberian mammoth at St. Petersburg with lumps of flesh bearing the marks of wolves' teeth—all these, with all gaps and imperfections, he urged mankind to believe came into being in an instant. The preface of the work is especially touching, and ends with the prayer that science and Scripture may be reconciled by his theory, and "that the God of truth will deign so to use it, and if he do, to him be all the glory." * And at the close of the whole book he declares : "The field is left clear and undisputed for the one witness on the opposite side, whose testimony is as follows : "In six days Jehovah made heaven and earth, the sea, and all that in them is." This quotation he placed in capital letters, as the final refutation of all that the science of geology had built.

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* See Professor Marsh's address as President of the Society for the Advancement of Science, in 1879.

In other parts of Europe desperate attempts have been made in recent times to save the letter of our sacred books by the revival of a theory in some respects more striking. To shape this theory to recent needs, vague reminiscences of a text in Job regarding fire beneath the earth, and vague conceptions of speculations made by Humboldt and Laplace, were mingled with Jewish tradition. Out of the mixture thus obtained Schubert developed the idea that the Satanic "principalities and powers" formerly inhabiting our universe plunged it into the chaos from which it was newly created by a process accurately described in Genesis. Rougemont made the earth one of the "morning stars" of Job, reduced to chaos by Lucifer and his followers, and thence developed in accordance with the nebular hypothesis. Kurtz evolved from this theory an opinion that the geological disturbances were caused by the opposition of the Devil to the rescue of our universe from chaos by the Almighty. Delitzsch put a similar idea into a more scholastic jargon ; but most desperate of all were the statements of Dr. Anton Westermeyer, of Munich, in his "The Old Testament vindicated from Modern Infidel Objections." The following passage will serve to show his ideas : "By the fructifying brooding of the Divine spirit on the waters of the deep, creative forces began to stir ; the devils who inhabited the primeval darkness and considered it their own abode saw that they were to be driven from their possessions, or at least that their place of habitation was to be contracted, and they therefore tried to frustrate God's plan of creation and exert all that remained to them of might and power to hinder or at least to mar the new creation." So came into being "the horrible and destructive monsters, these caricatures and distortions of creation," of which we have fossil remains. Dr. Westermeyer goes on to insist that "whole generations called into existence by God succumbed to the corruption of the Devil, and for that reason had to be destroyed" ; and that "in the work of the six days God caused the devil to feel his power in all earnest, and made Satan's enterprise appear miserable and vain." †

Such is the last important assault upon the strongholds of geological science in Germany ; and, in view of this and others of the same kind, it is little to be wondered at that, when, in 1870, Johann

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* See Gosse, "Omphalos," London, 1857, p. 5, and *passim ;* and for a passage giving the key-note of the whole, with a most farcical note on coprolites, see pp. 353, 354.

† See Shields's "Final Philosophy," pp. 340 *et seq.*, and Reusch's "Nature and the Bible" (English translation, 1886), vol. i, pp. 318–320.

Silberschlag made an attempt to again base geology upon the Deluge of Noah, he found such difficulties that, in a touching passage, he expressed a desire to get back to the theory that fossils were "sports of Nature." *

But the most noted among efforts to keep geology well within the letter of Scripture is of still more recent date. In the year 1885 Mr. Gladstone found time, amid all his labors and cares as the greatest parliamentary leader in England, to take the field in the struggle for the letter of Genesis against geology.

On the face of it his effort seemed Quixotic, for he confessed at the outset that in science he was "utterly destitute of that kind of knowledge which carries authority," and his argument soon showed that this confession was entirely true.

But he had some other qualities of which much might be expected —great skill in marshaling words, great shrewdness in adapting the meanings of single words to conflicting necessities in discussion, wonderful power in erecting showy structures of argument upon the smallest basis of fact, and a facility almost preternatural in "explaining away" troublesome realities. So striking was his power in this last respect that a humorous London chronicler once stated that a bigamist had been advised, as his only hope, to induce Mr. Gladstone to "explain away" one of his wives.

At the basis of this theologico-geological structure, Mr. Gladstone placed what he found in the text of Genesis: "A grand four-fold division" of animated Nature "set forth in an orderly succession of times," and he arranged this order and succession of creation as follows: "First, the water population; secondly, the air population; thirdly, the land population of animals; fourthly, the land population consummated in man."

His next step was to slide in upon this basis the apparently harmless proposition that this division and sequence "is understood to have been so affirmed in our time by natural science that it may be taken as a demonstrated conclusion and established fact."

Finally, upon these foundations he proceeded to build an argument out of the coincidences thus secured between the record in the Hebrew sacred books and the truths revealed by science as regards this order and sequence, and he easily arrived at the desired conclusion with which he crowned the whole structure, namely, as regards the writer of Genesis, that "his knowledge was divine." †

Such was the skeleton of the structure; it was abundantly decoated with the rhetoric in which Mr. Gladstone is so skillful an artificer, and it towered above "the average man" as a structure beautiful

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* See Reusch, vol. i, p. 264.

† See Mr. Gladstone's "Dawn of Creation and Worship," a reply to Dr. Réville, in the "Nineteenth Century," for November, 1885.

and invincible—like some Chinese fortress in the nineteenth century, faced with porcelain and defended with bows and arrows.

But its strength was soon seen to be unreal. A single shot from a leader in the army of science wrecked it. In an essay admirable in its temper, overwhelming in its facts, and absolutely convincing in its argument, Professor Huxley, late President of the Royal Society, and doubtless the most eminent living authority on the scientific questions concerned, took up the matter.

Mr. Gladstone's first proposition, that the sacred writings give us a great "fourfold division" created "in an orderly succession of times," Professor Huxley did not presume to gainsay.

But, as to Mr. Gladstone's second proposition, that "this great fourfold division . . . created in an orderly succession of times . . . has been so affirmed in our own time by natural science that it may be taken as a demonstrated conclusion and established fact," Professor Huxley showed that, as a matter of fact, no such "fourfold division" and "orderly succession" exist; that, so far from establishing Mr. Gladstone's assumption that the population of water, air, and land followed each other in the order given, "all the evidence we possess goes to prove that they did not"; that the distribution of fossils through the various strata proves that some land animals originated before sea animals; that there has been a mixing of sea, land, and air "population" utterly destructive to the "great fourfold division" and the creation "in an orderly succession of times"; that so far is the view presented in the sacred text, as stated by Mr. Gladstone, from having been "so affirmed in our own time by natural science, that it may be taken as a demonstrated conclusion and established fact" that Mr. Gladstone's assertion is "directly contradictory to facts known to every one who is acquainted with the elements of natural science"; that Mr. Gladstone's only geological authority, Cuvier, had died more than fifty years before, when geological science was in its infancy [and he might have added, when it was necessary to make every possible concession to the Church], and, finally, he challenged Mr. Gladstone to produce any contemporary authority in geological science who would support his so-called scriptural view. And, when in a rejoinder Mr. Gladstone attempted to support his view on the authority of Professor Dana, Professor Huxley had no difficulty in showing from Professor Dana's works that Mr. Gladstone's inference was utterly unfounded.

Both the scientific and theological world remained silent; there was nothing more to be said.

This being the case, Mr. Gladstone's wonderful fabric of coincidences between the "great fourfold division" in Genesis and the facts ascertained by geology fell of themselves. Professor Huxley's blow had shattered the central proposition—the key-stone of the supporting arch—and the last great fortress of the opponents of unfettered scientific investigation was in ruins.

But, in opposition to this attempt by a layman, we may put a noble utterance by a clergyman who has probably done more to save what is essential in Christianity among English-speaking people than any other ecclesiastic of his time. The late Dean of Westminster, Dr. Arthur Stanley, was widely known and beloved on both continents. In his memorial sermon after the funeral of Sir Charles Lyell he said: "It is now clear to diligent students of the Bible that the first and second chapters of Genesis contain two narratives of the creation side by side, differing from each other in almost every particular of time and place and order. It is well known that, when the science of geology first arose, it was involved in endless schemes of attempted reconciliation with the letter of Scripture. There was, there are perhaps still, two modes of reconciliation of Scripture and science, which have been each in their day attempted, *and each has totally and deservedly failed.* One is the endeavor to wrest the words of the Bible from their natural meaning and *force it to speak the language of science.*" And again, speaking of the earliest known example, which was the interpolation of the word "not" in Leviticus xi, 6, he continues: "This is the earliest instance of *the falsification of Scripture to meet the demands of science;* and it has been followed in later times by the various efforts which have been made to twist the earlier chapters of the book of Genesis into *apparent* agreement with the last results of geology—representing days not to be days, morning and evening not to be morning and evening, the Deluge not to be the Deluge, and the ark not to be the ark."

After a statement like this we may fitly ask: Which is the more likely to strengthen Christianity for its work in the twentieth century which we are now about to enter—a large, manly, honest, fearless utterance like this of Arthur Stanley, or hair-splitting efforts, bearing in their every line the germs of failure, like that made by Mr. Gladstone?

The world is finding that the scientific revelation of creation is ever more and more in accordance with worthy conceptions of that great Power working in and through the universe. More and more it is seen that inspiration has never ceased, and that its prophets and priests are not those who work to fit the letter of its older literature to the needs of dogmas and sects, but those who patiently, fearlessly, and reverently devote themselves to the search for truth as truth, in the faith that there is a Power in the universe strong enough to make truth-seeking safe and good enough to make truth-telling wise.

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